TRANSMISSION LINE STRUCTURE AND METHOD OF ATTACHING TRANSMISSION LINE STRUCTURE TO CONDUCTIVE BODY

CROSS REFERENCE

[0001] This application claims priority to U.S. Provisional Patent Application No. 61/883,567, filed Sep. 27, 2013, the contents of which are herein incorporated by reference in their entirety.

BACKGROUND

Technical Field

[0002] The exemplary and non-limiting embodiments disclosed herein relate generally to transmission line structures in electronic devices and, more particularly, to a planar transmission line structure in an electronic device, the planar transmission line structure being attached to a conductive chassis. The exemplary and non-limiting embodiments disclosed herein also relate to methods of attaching the transmission line structure to the conductive chassis.

BRIEF DESCRIPTION OF PRIOR DEVELOPMENTS

[0003] Handheld electronic devices such as mobile phones generally use coaxial cables as feed lines to conduct radio frequency signals to an antenna. Within such a device, the radio frequency signal feed is maintained via a metal-plated contact pad welded to a metal chassis and a spring contact separately mounted to a printed wire board. Such a configuration limits design options of the device. Furthermore, the reliability of the contact between the spring contact and the contact pad may be compromised due to use of the device in humid conditions or upon continued flexing of the spring contact.

SUMMARY

[0004] The following summary is merely intended to be exemplary. The summary is not intended to limit the scope of the claims.

[0005] In accordance with one aspect, a method comprises mounting a grounding clip to a planar flexible printed circuit transmission line; clamping the grounding clip to an inner wall of a chassis of an electronic device; and operating a laser beam to weld the grounding clip to the chassis to route the flexible printed circuit transmission line along the inner wall. Welding the grounding clip to the chassis causes the grounding clip to remain in contact with the planar flexible printed circuit transmission line to ground the planar flexible printed circuit transmission line to the chassis.

[0006] In accordance with another aspect, an apparatus comprises at least one processor and at least one memory including computer program code, the at least one memory and the computer program code configured to, with the at least one processor, cause the apparatus to: mount a grounding clip to a planar flexible printed circuit transmission line; clamp the grounding clip to a chassis of an electronic device; and operate a laser beam to weld the grounding clip to the chassis.

[0007] In accordance with another aspect, an apparatus comprises a conductive chassis; a planar flexible printed circuit transmission line on an internal surface of the conductive chassis; and one or more clips attached to the conductive chassis and in contact with the planar flexible printed circuit transmission line to ground the planar flexible printed circuit transmission line to the conductive chassis.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The foregoing aspects and other features are explained in the following description, taken in connection with the accompanying drawings, wherein:

[0009] FIG. **1** is a perspective view of an interior portion of an electronic device showing a first planar flexible transmission line bonded to a chassis and grounded using mounting clips;

[0010] FIG. **2** is a perspective view of an interior portion of the electronic device of FIG. **1** showing a second planar flexible transmission line bonded to the chassis and grounded using mounting clips;

[0011] FIG. **3** is a perspective view of an elevated feed system implementing a flexible transmission line;

[0012] FIG. **4** is a schematic cutaway view of the elevated feed system of FIG. **3**;

[0013] FIG. **5** is a side sectional view of an alternate embodiment of an elevated feed system;

[0014] FIG. **6** is a perspective view of a process of clamping and welding clips to a chassis to ground a planar flexible transmission line;

[0015] FIG. **7** is a photograph taken with a stereo microscope of heat damage, cracking, and gas inclusion defects in a process of welding a clip to a chassis;

[0016] FIG. **8** is a photograph of a clip welded to a chassis;

[0017] FIG. **9** is a photograph taken with a stereo microscope showing a proposed welding quality target;

[0018] FIG. **10** is a graphical illustration of a design of experiment setup for a process of attaching a planar flexible printed circuit transmission line to a metal chassis;

[0019] FIG. **11** is a graphical illustration of the results of the design of experiment setup of FIG. **10**; and

[0020] FIG. **12** is a flow illustrating a process of attaching a planar flexible transmission line to a chassis of an electronic device.

DETAILED DESCRIPTION OF EMBODIMENT

[0021] Fixed, portable, or handheld electronic devices that operate using radio frequency (RF) generally include housings in which electronic components are mounted on chassis fabricated of a conductive material such as metal or a material (e.g., polymer) containing a metal or other conductive material. In a handheld electronic device such as a mobile phone or notepad, the electronic components include one or more printed circuit boards (PCBs), a battery, and a display, all of which are stacked or otherwise arranged within an interior volume defined by the chassis. An RF feed is provided from an RF engine on the PCB to an associated antenna.

[0022] In the exemplary embodiments disclosed herein, the RF feed is from the RF engine to the antenna via one or more planar transmission structures (transmission lines) that include flexible printed circuits, the transmission lines being attached to conductive side walls of the chassis and being grounded to the chassis. The transmission lines attached to the conductive sides walls of the chassis are routed around an inner perimeter of the chassis, thereby saving space within the electronic device and facilitating the optimal placement of control and RF circuitry on the PCB. Attaching the transmis-